A 242

OPERATION & MAINTENANCE HANDBOOK

MODEL 88 PULSE 'N POWER PAC COMBO
MODEL 99 PULSE GENERATOR
LA0242/-

DEPT. 105

SYSTRON-DONNER CORPORATION
DATAPULSE

10150 W. Jefferson Blvd., Culver City, Calif. 90230
Tel: (213) 836-6100; TWX: 910-340-6766; Telex: 67-3219

OPERATION & MAINTENANCE MANUAL

MODEL 88 PULSE 'N POWER PAC COMBO * MODEL 99 PULSE GENERATOR

SYSTRON-DONNER CORPORATION

DATAPULSE

DATAPULSE DIVISION, SYSTRON-DONNER CORPORATION
10150 West Jefferson Boulevard, Culver City, California 90230
Telephone: 213/836-6100 TWX: 910-340-6766

MODEL 88 PULSE 'N POWER PACK COMBO
MODEL 99 PULSE GENERATOR

TABLE OF CONTENTS
******

General description & pictures 1

SECTION I - SPECIFICATIONS

1.1 Repetition Rate 2
1.2 External Trigger 2
1.3 Delay 2
1.4 Width 2
1.5 Amplitude 2
1.6 Output Polarity 2
1.7 Transition Times 2
1.8 Sync Output 2
1.9 Output Protection 2
1.10 Power Required 2
1.11 Operating Temperature 2
1.12 Physical Characteristics 3
1.13 Accessories Furnished 3
1.14 Power Supply Specifications 3

SECTION II - OPERATION

2.1 Controls & Connectors 4
2.2 Operating Instructions 5
2.3 Application Notes 6

SECTION III - THEORY OF OPERATION

3.1 General Description 8
3.2 Detailed Circuit Description 9

SECTION IV - MAINTENANCE

4.1 Preventive Maintenance 15
4.2 Parts Replacement 15
4.3 Specification Verification 16

SECTION V - PARTS LIST

5.1 Abbreviations & Symbols 19
5.2 Front Panel Assembly - Model 88/99 20
5.3 Main Circuit Board Assembly 20
5.4 Back Panel Assembly - Model 88/99 24

LIST OF SCHEMATICS, TABLES AND PHOTOGRAPHS

Front Panel Photographs - Model 88/99 4
Pictorial Examples of Proper/Improper Termination 7
Non-Standard Line Connection Table 5
Pulse Generator Schematic - Model 88/99 12
Power Supply Schematic - Model 88 14

DATAPULSE MODEL 88
PULSE/POWER PACK COMBINATION

DATAPULSE MODEL 99 PULSE GENERATOR

MODEL 88/99 PULSE GENERATOR

The Model 88/99 Pulse Generator is a versatile and compact laboratory instrument capable of generating pulses at repetition rates up to 20 MHz. Pulse widths are variable from < 20 ns to > 200 ms and pulse amplitude is variable from < 1 V to > 5 V into 50 ohms. A connector is provided for triggering the instrument from an external source. The Model 88 has the added feature of +5 volt, 1 amp dc output.

SECTION I

SPECIFICATIONS

1.1 REPETITION RATE

Variable from < 2 Hz to > 20 MHz in 7 overlapping ranges.

1.2 EXTERNAL TRIGGER

DC to > 20 MHz. Trigger must be > +2 V amplitude (0 V baseline) and > 15 ns width.

1.3 DELAY

Fixed at approximately 10 ns nominal. Delay is measured between the 50% points of the leading edges of the sync output and the main output pulse.

1.4 WIDTH

Variable from < 20 ns to > 200 ms in 7 overlapping ranges. Maximum duty factor is at least 75% for repetition rates < 10 MHz, decreasing to 60% at 20 MHz.

1.5 AMPLITUDE

Pulse amplitude is variable from < 1 V to > 5 V into 50 ohms. Baseline is fixed at 0 ±0.25 V. Sink current is 40 mA maximum.

1.6 OUTPUT POLARITY

Output polarity is positive.

1.7 TRANSITION TIMES

Rise and fall times are 7 ns maximum, 5 ns typical. Transition times are measured between the 10% and 90% amplitude points.

1.8 SYNC OUTPUT

> +2 V into 50 ohms (approximately 0 V baseline). Width is approximately 15 ns.

1.9 OUTPUT PROTECTION

Protected against damage from any combination of front panel controls, output open or short circuits and back voltages between -5 and +10 volts.

1.10 POWER REQUIRED

Approximately 10 W maximum at 90-138/180-276 V and 50-60 Hz ac.

1.11 OPERATING TEMPERATURE

0 to 50° C.

1.12 PHYSICAL CHARACTERISTICS

Front panel is brushed aluminum finish with black markings. Input and output connectors are BNC type. Weight is approximately 3¼ lbs. Dimensions are 7" W (tapering to 6¼") x 3¼" H (tapering to 2-3/8") x 8-1/8" D.

1.13 ACCESSORIES FURNISHED

One operation and maintenance manual.

NOTE: The following specifications are applicable for the Model 88 only.

1.14 POWER SUPPLY SPECIFICATIONS

1.14.1 Output Voltage

+5 volts ±2%.

1.14.2 Voltage Variations

±1% for line voltage variations from 90-138/180-276 volts, load variations from 0-1 amp and temperature variations from 0 to 50° C.

1.14.3 Ripple

<5 mV peak-to-peak.

1.14.4 Current

>1 amp.

1.14.5 Current Limiting

Foldback type with initial limiting at approximately 1.25 amps.

1.14.6 Short Circuit Current

Approximately 0.8 amp.

1.14.7 Overvoltage Protection

Crowbar type protects against internal and external overvoltages and transients. After a transient, the instrument must be reset by cycling the power switch.

1.14.8 Overload Indication

Pilot lamp flashes during current overload or after an overvoltage condition has occured.

1.14.9 Power Required

Approximately 30W at 90-138/180-276V ac and 50-400Hz.

SECTION II

OPERATION

2.1 CONTROLS AND CONNECTORS

Refer to Figure 2-1 for the location of controls and connectors.

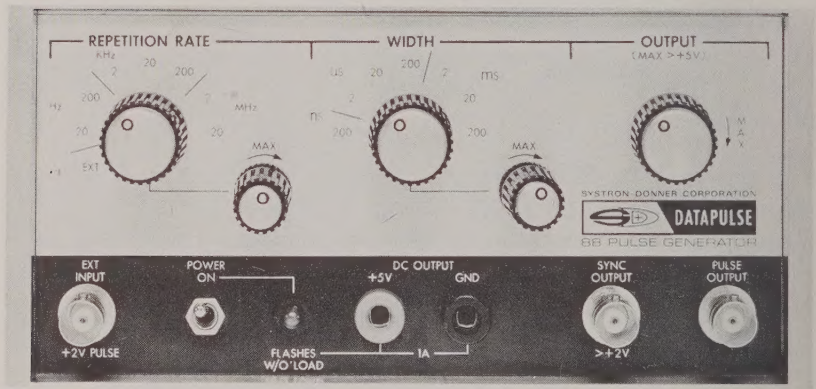


FIGURE 2-1. Model 88 Front Panel

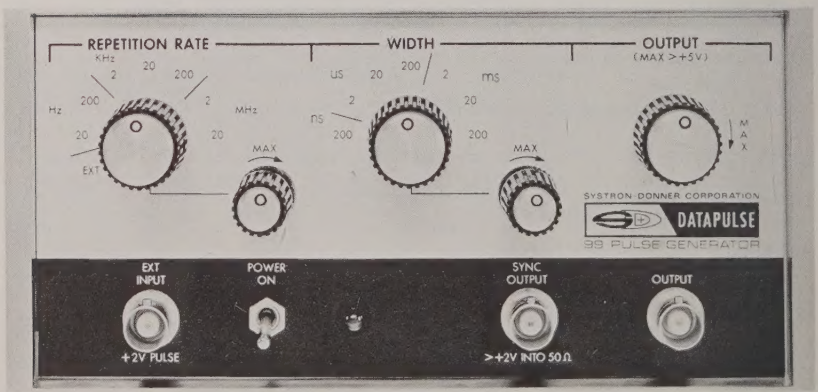


FIGURE 2-1. Model 99 Front Panel

2.1.1 POWER Switch

Applies ac power to the instrument.

2.1.2 REPETITION RATE Controls

The rotary switch selects the repetition rate range or external triggering and the vernier provides continuous control within the range selected. In the EXT position the instrument can be triggered by an external trigger source at the EXT INPUT.

2.1.3 WIDTH Controls

The rotary switch selects the width range and the vernier provides continuous control within the range selected.

2.1.4 OUTPUT Control

Varies the amplitude of the output pulse from <1 V to >5 V.

2.1.5 EXT INPUT

Input connector for an external trigger source.

2.1.6 SYNC OUTPUT

Output connector for the sync pulse.

2.1.7 OUTPUT

Output connector for the main pulse.

2.1.8 DC OUTPUT (Model 88 only).

Output connector for the +5V, 1 amp power supply.

2.2 OPERATING INSTRUCTIONS

2.2.1 General Instructions

The Model 88/99 is fully protected and no combination of front panel control settings, short circuit or external voltage between -5V and +10V will cause damage. The fuse is located inside the unit on the PC board. The proper size fuse is 1/2 amp slow-blow for the Model 99 and 1 amp for the 88. When the instruments leave the factory, they are wired for 105-138V ac power input unless otherwise specified. For line connections other than 105-138V ac, refer to Table 2-1. CAUTION: Always verify that the line connections agree with the power source prior to connecting the power plug. Colors refer to the transformer wires and letters to labeled eyelets on the PC board.

TABLE 2-1

Power Source	Wire Color and Connection			
	Red	Red/Wht	Blk	Blk/Wht
90-115	F	E	A	B
105-138	E	F	B	A
180-230	F	D	A	C
210-275	D	F	C	A

2.2.1.1 Duty Factor Limitation

Duty factor is defined as the ratio of the pulse duration to the duration of the total repetition rate period. The maximum duty factor is at least 75% for repetition rates <10MHz, decreasing to 60% at 20 MHz.

2.2.1.2 Output Termination

The Model 88/99 output impedance is very low and will operate without an output termination. However, for minimum aberrations and reflections, the output should be terminated with 50 ohms and 50 ohm interconnection cables should be used (see applications section).

2.2.2 External Trigger Operation

Setting the REPETITION RATE selector to EXT makes triggering possible by an external source at repetition rates from dc to >20 MHz. To operate the instrument in the external trigger mode, proceed as follows:

a. Set the REPETITION RATE selector to EXT and connect the external trigger source to the EXT INPUT.

b. Set the external source for a +2 V output and a width >15 ns. Set the source for the desired repetition rate.

c. Set the Model 88/99 WIDTH controls for the desired width, observing duty factor limitations, and OUTPUT control for the desired amplitude.

d. Connect the OUTPUT connector to the device under test. Terminate the OUTPUT with 50 ohms for minimum reflection if the test device impedance is not 50 ohms.

e. If synchronization is required, connect the SYNC OUTPUT to the test device or oscilloscope.

2.2.3 Internal Trigger Operation

When the REPETITION RATE selector is not in the EXT position, the triggering rate of the Model 88/99 is determined by the repetition rate range selected. To operate the instrument in the internal trigger mode, proceed as follows:

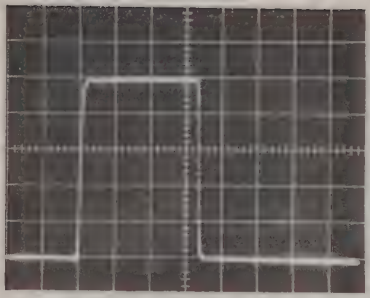
a. Set the REPETITION RATE controls for the desired repetition rate. Set the WIDTH controls for the desired width, observing duty factor limitations, and the OUTPUT controls for the desired amplitude.

b. Perform steps (d) and (e) of paragraph 2.2.2.

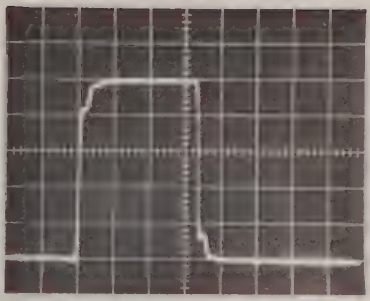
2.3 APPLICATION NOTES

2.3.1 Output Termination

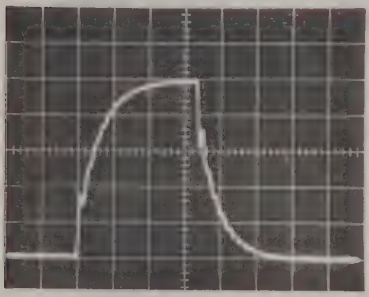
To obtain clean waveshapes and fast transition times, the Model 88/99 Pulse Generator must be terminated with a 50 ohm termina-



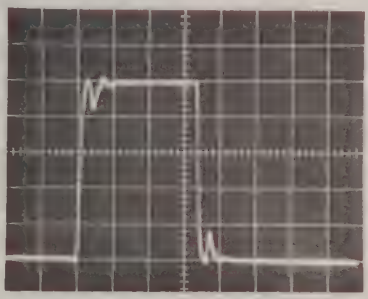
A 50 ns/cm, 1 V/cm. OUTPUT PROPERLY TERMINATED WITH 50 OHM USING 50 OHM INTERCONNECTING CABLES.



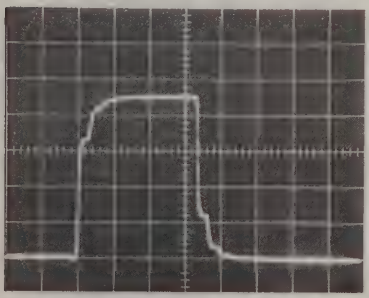
B 50 ns/cm, 1 V/cm. OUTPUT USING 75 OHM INTERCONNECTING CABLES



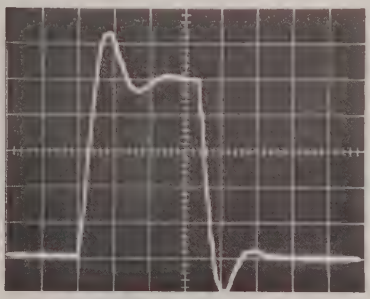
C. 50 ns/cm, 1 V/cm. OUTPUT USING 3-FOOT CLIP LEADS



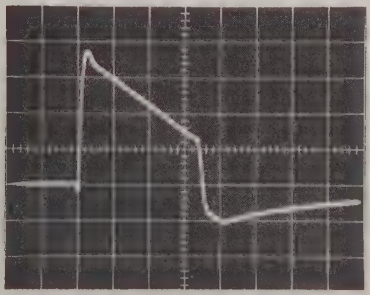
D 50 ns/cm, 1 V/cm. OUTPUT USING 50 OHM CABLE WITH CLIP LEAD CONNECTED TO THE LOAD



E. 50 ns/cm, 1 V/cm. OUTPUT USING 50 OHM CABLE AND 25 OHM TERMINATION.



F. 50 ns/cm, 1 V/cm. OUTPUT TERMINATED WITH 50 OHM DRIVING A 390 pF CAPACITIVE LOAD (transistors, capacitors, etc.).



G. 50 ns/cm, 1 V/cm. OUTPUT TERMINATED WITH 50 OHM DRIVING A 2.2 μH INDUCTIVE LOAD (transformer, inductor, etc.).

FIGURE 2-2. EFFECTS OF TERMINATION AND CABLING ON OUTPUT WAVEFORM

tion at the load. Interconnecting cables must also have an impedance of 50 ohms. Figures 2-2a through 2-2g show the effects of proper and improper termination or cabling.

2.3.2 Reactive Loads

Since the instrument has a low output impedance, the transients produced by inductive loads are usually damped. However, if the inductive load is too large, damage may be caused to the instrument.

2.3.3 Duty Cycle

In order to maintain a stable and undistorted output, duty cycle limitations must not be exceeded. Always refer to paragraph 1.4 for duty cycle limitations when operating the instrument.

2.3.4 Output Mixing

The mixing of output pulses from two or more units can be accomplished by using a Datapulse 2302 Pulse Mixer.

2.3.5 Variable Rise Time

The Datapulse 2401 Rise Time Integrator, available as an accessory, provides for variable control of the rise time up to more than 40 ns. The 2401 connects in series with the output and requires no external power.

2.3.6 Delayed Output

By triggering one instrument with another through a Datapulse 2101 Inverting Transformer and some simple circuitry, variable delay of the output can be accomplished. Contact factory for further information.

SECTION III

THEORY OF OPERATION

3.1 GENERAL DESCRIPTION

Time reference for the instrument is provided either by the oscillator or an external trigger source. When an external source is provided, the oscillator is disabled. The oscillator generates rectangular pulses that are differentiated then utilized to trigger the width one-shot.

The width one-shot is basically a monostable multivibrator which remains in its stable state until it is triggered by the leading edge of the differentiated pulse from the oscillator. It then switches to an unstable state for a time period determined by its timing capacitor. This period of time determines the width of the output pulse.

In the output amplifier, the pulse from the width one-shot is

amplified and output amplitude control is provided. The width one-shot output is also differentiated with the leading edge driving an amplifier which provides the sync output to the front panel.

3.2 DETAILED CIRCUIT DESCRIPTION

For paragraphs 3.2.1 through 3.2.5 refer to Schematic 40000-504.

3.2.1 Oscillator

The oscillator generates the internal trigger and also functions as an external trigger amplifier when repetition rate switch S1 is in the EXT position. Integrated circuit Z1A is connected as a Schmitt trigger and with S1 in any position except EXT, one of the timing capacitors (C2-C8) is connected to Z1A pin 10 and feedback to pin 10 is taken through R7 and R8 from Z1A pin 14. Assuming that Z1A pin 14 is at its lower level (approximately 0.25 V) pin 11 will be at the same level. Pin 10 does not step immediately to this level because the voltage across the timing capacitor cannot change instantaneously. The capacitor discharges through R6, R7 and R8 until the voltage at pin 10 reaches the level of the voltage at pin 11, the output of Z1A (pin 14) then shifts to its upper level (approximately +1.2 V). Again, the voltage at pin 10 does not follow immediately and the timing capacitor charges toward the level at pin 14. When the charge on the capacitor reaches that level, Z1A shifts to its lower level and the cycle repeats itself. The time required to charge the timing capacitor in both directions determines the repetition rate of the oscillator.

When the repetition rate switch S1 is in the EXT position, the feedback path to Z1A pin 10 is disconnected and Z1A functions as a Schmitt trigger. The input signal is shaped so that the output of Z1A is a fast transition time pulse with +1.5 V amplitude and the approximate width of the input, independent of the input transition times and levels. Resistor R2, CR1, CR2 and CR3 provide input overvoltage protection.

For all positions of the repetition rate switch, the output from Z1A is differentiated by the network consisting of C9, R10 and L1. The negative spike is inverted by Z1B to provide the trigger pulses for the width one-shot.

3.2.2 Width One-Shot

Differential amplifier Z1C, timing resistor R104 and timing capacitors C103-C109 comprise the width one-shot. Pin 12 of Z1C is biased at approximately +0.5 V dc by diode CR101 keeping pin 15 of Z1C at +1.2 V dc between pulses. When a pulse occurs at Z1C pin 13, the level at pin 15 drops to 0 V dc. The transient caused by this step is coupled through the timing capacitor to pin 12, causing pin 15 to remain at 0 V dc while the timing capacitor charges positively through R104. When the voltage at pin 12 is great enough to overcome the bias at pin 13, pin 15 shifts to +1.2 V. The period of time that pin 15 remains at 0 V dc is determined by the value of the timing capacitor (C103-C109) and the setting of width vernier R104.

3.2.3 Output Amplifier

Prior to final amplification, the negative-going pulse from the width one-shot is level shifted by diodes CR302 and CR303 to drive the differential amplifier formed by Q301 and Q302. Inductor L301, diode CR301 and resistors R301 and R302 form a peaking network. Transistor Q301 is normally on as its base is approximately 0 V dc while the base of Q302 is biased at -1.2 V dc. The incoming pulse turns Q301 off causing a positive pulse at its collector. This signal is shifted 3.3 V negative by zener diode CR304, differentiated by L351 and coupled to the sync output amplifier (paragraph 3.2.4).

Before the incoming pulse goes negative, Q302 is off allowing all the current from R310 to drive the base of Q304 thereby turning it on. Diode CR306 prevents Q304 from saturating and keeps its collector at approximately +0.3 V dc. When Q302 is turned on, it draws all the current from R310 plus 10 mA causing Q304 to be turned off and diode CR307 to be forward biased to approximately -0.7 V. The collector voltage of Q304 then rises to a level determined by the clamp diode CR310 and the clamp voltage set by transistor Q305. The clamp voltage, and thus the swing at the collector of Q304 is determined by the setting of the amplitude control potentiometer R313.

Parallel emitter-followers Q305 and Q306 provide current gain to drive the output. Transistor Q307 keeps the pulse fall time from slowing when the output is connected to a capacitive load. Transistor Q307 also provides current sinking capability. Resistor R322 protects output transistors Q305 and Q306 against short circuits.

3.2.4 Sync Output Amplifier

The input to the sync output amplifier is the differentiated pulse from Q301. Diode CR352 clips the negative-going half of the differentiated pulse and the positive-going half turns emitter-follower Q308 on. The amplitude of the sync output is >+2 V into 50 ohms.

3.2.5 Power Supply

The power supply consists of three regulators: +10 V, -5 V and +2 V. The +10 V and -5 V regulator are almost identical, with the exception that transistor Q511 is used as a current source for series pass transistor Q512 and error amplifier Q513 in the +10 V regulator. However, in the -5 V regulator, fixed resistor R521 is used as the current source. Since the two regulators are almost identical, only the +10 V regulator will be explained.

The stepped-down ac voltage is rectified by bridge diodes CR511-CR514 and filtered by capacitor C511. Unregulated dc voltage is applied at the collector of series pass transistor Q512. Current source Q511 supplies approximately 10 mA at the junction of the base of Q512 and R513. The amount of quiescent current flowing in the collector of Q513 is determined by the load current and transistor gain. If the voltage at the regulator output tries to increase, the change is coupled by reference diode CR517 to the base of Q513 increasing the collector current of Q513 which in

turn decreases the base current of the series pass transistor, resulting in a decrease in the output voltage. Similarly, if the regulator output voltage decreases, the current through error amplifier Q513 decreases, resulting in an increase in the regulator output.

Overcurrent protection for the regulator is provided by transistor Q514. During normal operating conditions, Q514 is biased off by the voltage divider consisting of R514 and R515. When the current increases above the regulator limit, Q514 is turned on by the voltage drop across R516 and keeps the output current at or below the limit level, by diverting base current from Q512.

The +2 V regulator is comprised of differential amplifier Z1D, Q518 and associated circuitry. Differential amplifier Z1D is biased so that when the regulator output is +2 V, pin 5 is at 0 V. A change in the regulator output changes the bias at pin 5 causing the output at pin 2 to follow the input. This voltage change at pin 2 of Z1D causes an opposite change at the collector of Q518, thereby returning the regulator output voltage to the desired level (+2 V).

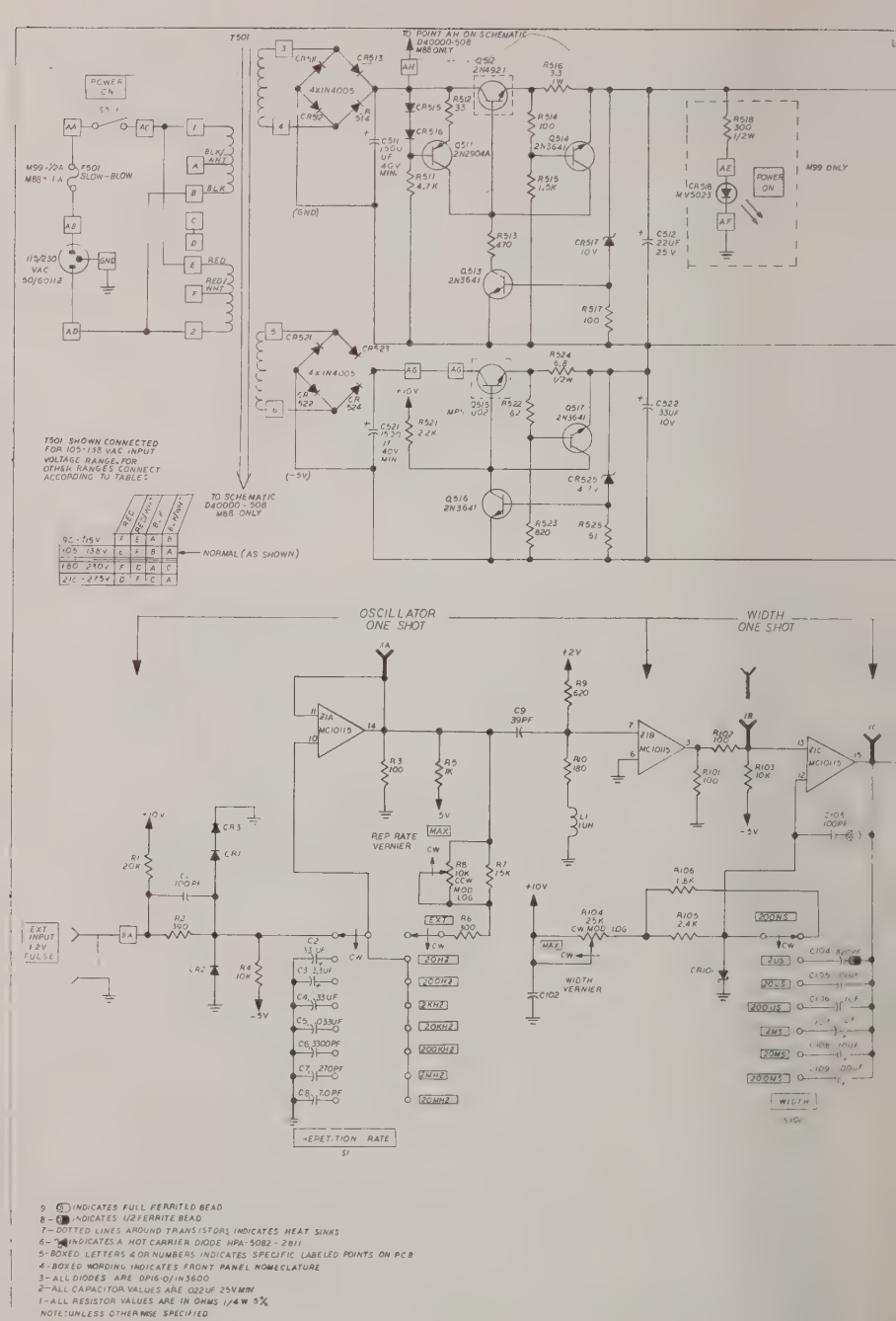
3.2.6 Power Supply (Model 88 only)

Refer to Schematic 40000-508 for the following explanation. Unregulated voltage is present at the collector of Darlington transistor Q552. Reference voltage for the regulator is provided by zener diode CR557 and the regulator output is adjusted to +5 V by R559. Transistor Q551 is the constant current source for CR557.

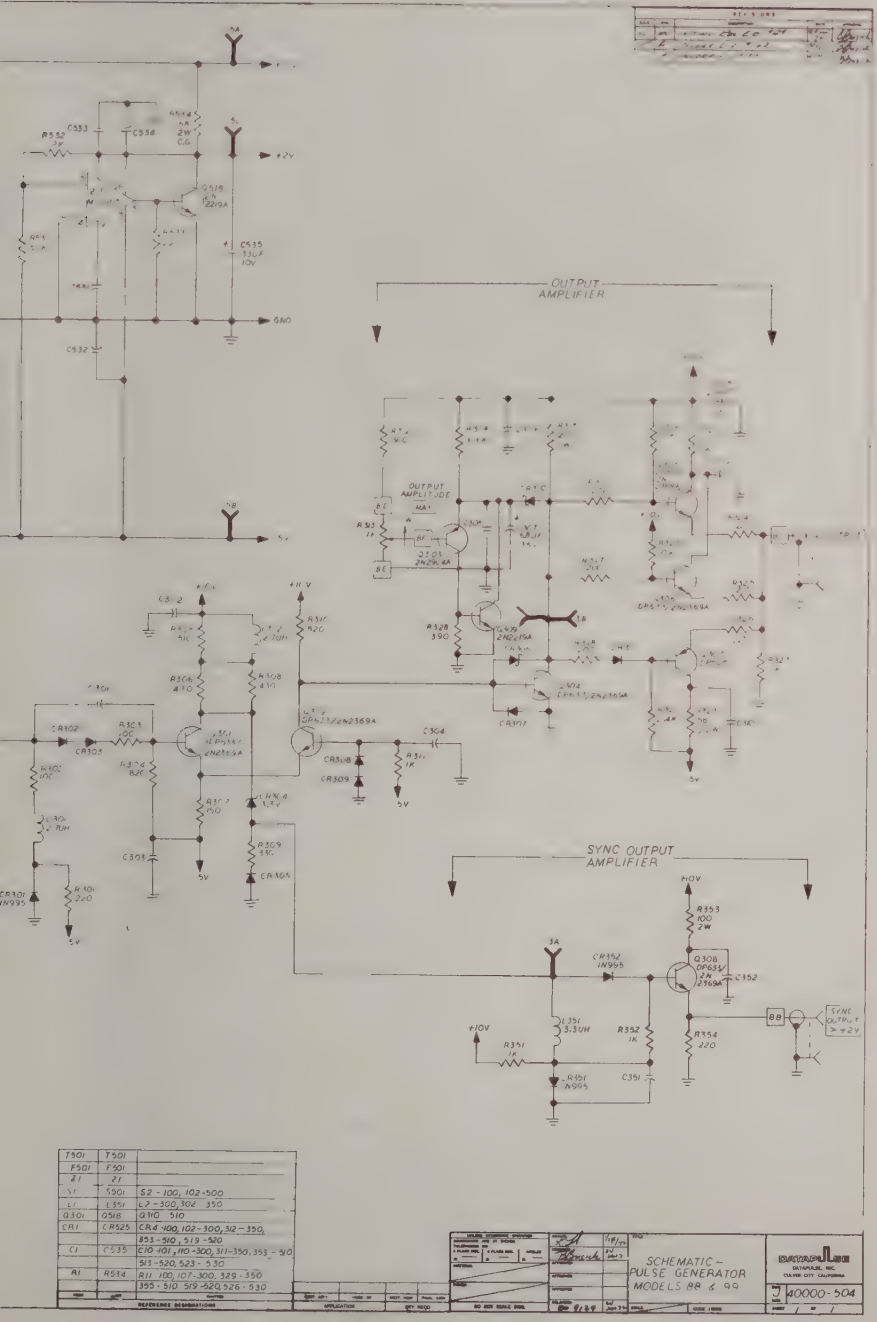
During normal operation, the voltages at pin 4 and 5 of error amplifier Z551 are equal. Any error sensed at the regulator output causes a difference to occur between the two inputs (pin 4 and 5) of Z551. This error voltage is applied to the base of Darlington transistor Q552 which causes a proportional change in its emitter current, thereby correcting for the regulator output error.

Overload protection is provided by transistor Q553. When an overload occurs, Q553 is turned on by the voltage drop across R555 diverting base current from Q552 and thus limiting the output current to a safe value. An overload condition causes pilot lamp CR560 to flash. The overload current through Q553 turns Q554 on. With Q554 on, base current is supplied to Q556 which saturates and enables the bi-stable multivibrator (Q555 and Q557).

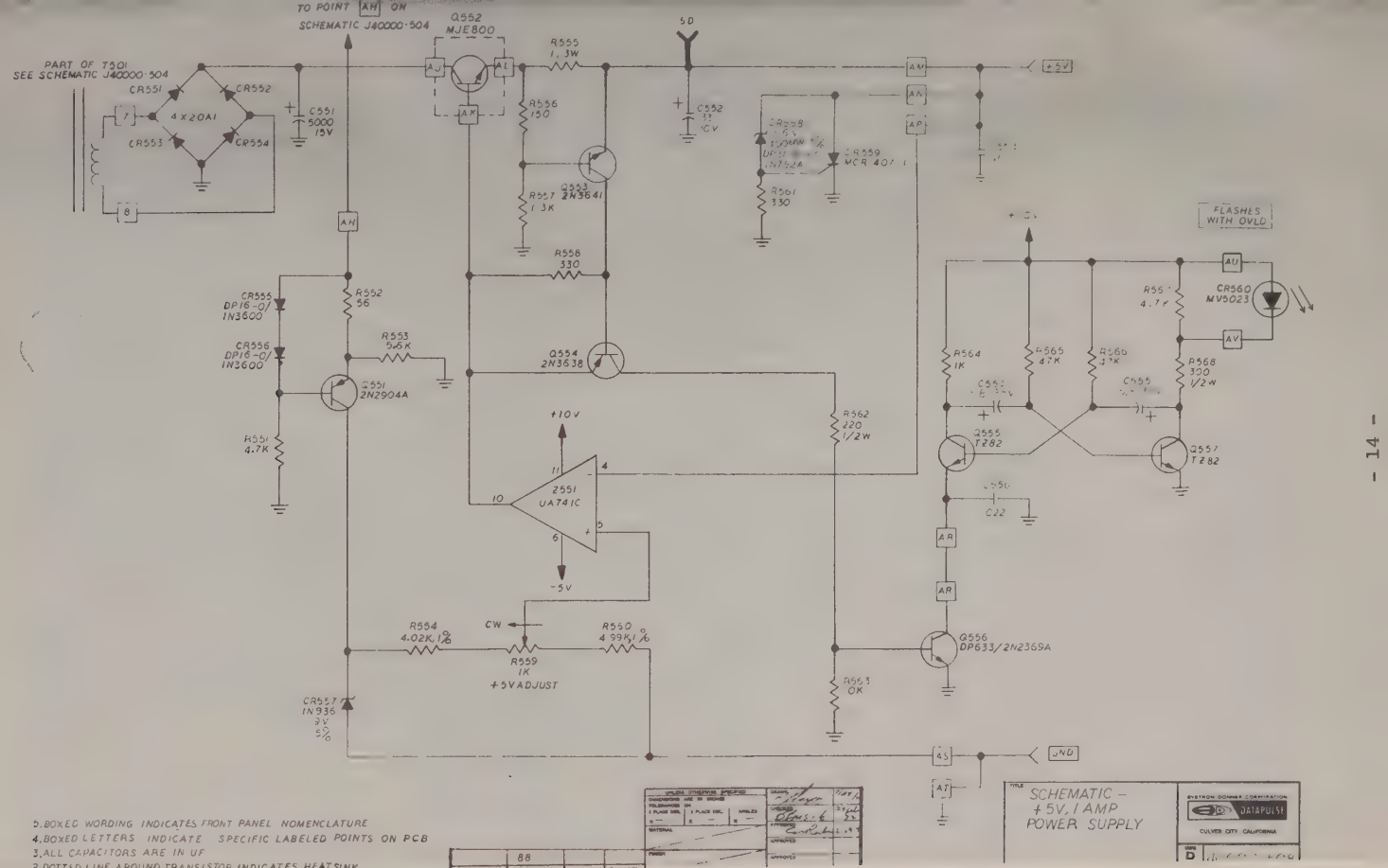
The overvoltage protection circuit consists of zener diode CR558 and control rectifier CR559. If the regulator output exceeds 5.6 V, the gate of CR559 is turned on and the output is shorted to ground and remains in this state until reset by removing the overvoltage condition and cycling the power switch off and on. When CR559 is turned on after an overvoltage transient, the supply will automatically go into an overvoltage condition which will cause the pilot lamp CR560 to flash as described above.



9 - INDICATES FULL FERRITE BEAD
8 - INDICATES 1/2 FERRITE BEAD
7 - DOTTED LINES AROUND TRANSISTORS INDICATES HEAT SINKS
6 - INDICATES A HOT CARRIER DIODE HPA-5082-2811
5 - BOXED LETTERS & OR NUMBERS INDICATES SPECIFIC LABELED POINTS ON PCB
4 - BOXED WORDING INDICATES FRONT PANEL NOMECLATURE
3 - ALL DIODES ARE DP16-0/1N3600
2 - ALL CAPACITOR VALUES ARE .022UF 25V MIN
1 - ALL RESISTOR VALUES ARE IN OHMS 1/4W 5%
NOTE: UNLESS OTHERWISE SPECIFIED



T501	T501	
F501	F501	
Z1	Z1	
S1	S501	S2 - 100, 102-500
L1	L351	L2 -300, 302 350
Q301	Q518	Q140 510
CR1	CR525	CR4 -100, 102-300, 312-350, 353-510, 519-520
C1	C535	C10-101, 110-300, 311-350, 353-510, 513-520, 523-530
R1	R514	R11 100, 107-300, 329-350 355-510 519-520, 526-530



5. BOXED WORDING INDICATES FRONT PANEL NOMENCLATURE
4. BOXED LETTERS INDICATE SPECIFIC LABELED POINTS ON PCB
3. ALL CAPACITORS ARE IN UF
2. DOTTED LINE AROUND TRANSISTOR INDICATES HEATSINK

88

SCHEMATIC – +5V, 1 AMP POWER SUPPLY

BYSTRON DONNER CORPORATION DATAPULSE CULVER CITY, CALIFORNIA

SIZE D

SECTION IV

MAINTENANCE

4.1 PREVENTIVE MAINTENANCE

Proper care and correct use with regularly scheduled inspections provide the best protection against unnecessary repairs and down time. Datapulse Model 88/99 is a sensitive laboratory instrument and should not be exposed to severe environmental conditions either in use or in storage. Contaminating or damaging exposure must be avoided at all times if long life and uninterrupted service are expected.

4.1.1 Inspection

Inspect for dirt and corrosion and for obvious physical damage. Inspection intervals should be based on frequency of use and the severity of the environment to which the instrument is exposed.

4.1.2 Cleaning

Accumulated dust and dirt should be removed as often as required. Use either low velocity dry air or a soft nonmetallic brush to clear the interior of foreign matter. Clean dirty parts with a solvent such as trichlorethylene using a soft cloth and a cotton tipped applicator for narrow spaces.

4.1.3 Calibration

The Model 99 has no calibration adjustments. The Model 88 has one calibration adjustment. Perform paragraph 4.3.6 steps (a) and (b) if the DC OUTPUT reading becomes out of tolerance.

4.2 PARTS REPLACEMENT

A procedure should be carefully thought out before a part is removed to avoid unnecessary disassembly and accidental damage. Use only direct replacements for parts affecting performance. Transistors temporarily removed should be returned to their original locations unless defective.

4.2.1 Power Transistors

The power transistors for the dc power supplies are mounted on the back panel for heat dissipation. Fiber bushings and mica washers are used to electrically insulate the case (collector) from the heat sink (ground) and a thin film of thermal compound (Wakefield No. 122) is applied to both sides of the mica washers to insure proper thermal conductivity. Incorrectly installed, the transistors may either short out or overheat and fail.

4.2.2 Soldering

Only experienced technicians should replace soldered parts. Printed circuits are vulnerable to excess heat as are many diodes and transistors. The following recommendations should be taken into consideration when replacing soldered parts:

a. Use small diameter rosin core solder and a 35 to 40 watt iron with a wedge or pointed tip, 1/16 to 1/8 inch wide. The tip must be clean and properly tinned with excess solder removed.

b. Obviously defective parts may be clipped out so their leads can be conveniently unsoldered from the board.

c. Solder only on the circuit side of the board; not on the component side.

d. Apply the tip of the iron directly to the solder joint, at the eyelet, just long enough for the solder to flow.

e. Avoid bringing the iron into contact with the circuit board; overheating will cause the conductor to lift from the board.

f. Use a solder sipper (or some other means) to remove excess solder first when unsoldering a lead, particularly where a lead is bent over, so that it can be straightened before it is pulled out.

g. When a lead is free, clean the hole and remove excess solder, using a solder sipper or a sharp object such as a tooth pick or pointed tool.

h. To prevent heat damage when soldering heat sensitive components, use a heat sink or long nose pliers to grip the lead between the part and the board.

i. Clean the area thoroughly after soldering.

4.3 SPECIFICATION VERIFICATION

This paragraph is designed to compare the Model 88/99 against its published specifications.

4.3.1 Equipment (or equivalent) Required

a. Sampling oscilloscope with a 1 GHz bandpass capability. Tektronix Type 546 with a Type 1S1 plug-in recommended.

b. Real-time oscilloscope with a 50 MHz bandpass capability. Tektronix Type 546 with a Type 1A2 plug-in recommended.

c. Electronic counter capable of reading 20 MHz. Systron-Donner Model 6105 recommended.

d. Trigger source capable of 20 MHz repetition rate. Datapulse Model 116 Pulse Generator recommended.

e. Two 10X, 50 ohm, 2 watt attenuators. Datapulse Type 2015 recommended.

f. Two 50 ohm, 2 watt terminations. Datapulse Type 2010 recommended.

g. Three 50 ohm coaxial cables terminated with BNC connectors.

NOTE: The following equipment needed for Model 88 only.

h. Digital voltmeter capable of reading ac and dc millivolts. Systron-Donner Model 7000A with an 02 option recommended.

i. Autotransformer with a 3A capability.

j. A 5 ohm, 10 watt resistor.

4.3.2 Repetition Rate Verification

a. Set the instrument controls as follows:

Control	Setting
REPETITION RATE selector	20 Hz
REPETITION RATE vernier	fully counterclockwise
WIDTH selector	200 ns
WIDTH vernier	fully counterclockwise
OUTPUT vernier	MAX

b. Monitor the OUTPUT with the counter. Terminate the OUTPUT with 50 ohms at the counter input.

c. Verify that the repetition rate range from <2 Hz to >20 MHz is covered in the 7 overlapping ranges.

4.3.3 Width Verification

a. Set the instrument controls the same as in paragraph 4.3.2 step (a) except the REPETITION RATE selector to 2 MHz.

b. Monitor the OUTPUT with the sampling oscilloscope. Trigger the oscilloscope from the SYNC OUTPUT. Terminate both outputs with the 10X, 50 ohm, 2 watt attenuators at the oscilloscope.

c. Verify that the pulse width varies from <20ns to >200ms. Observe width duty factor limitations listed in the specifications by decreasing the frequency as the pulse width is increased. Use the real-time oscilloscope to check the widest (5) ranges.

4.3.4 Output Verification

a. Set the instrument controls as follows:

Control	Setting
REPETITION RATE selector	200 kHz
REPETITION RATE vernier	fully clockwise
WIDTH selector	200ns
WIDTH vernier	mid-range
OUTPUT vernier	MAX

b. Monitor the OUTPUT with the sampling oscilloscope. Trigger the oscilloscope from the SYNC OUTPUT.

c. Set the oscilloscope horizontal controls to display a single pulse on the trace. Verify that the amplitude is >+5 V and the transition times (rise and fall times) are <7 ns.

d. Rotate the OUTPUT vernier fully counterclockwise and verify that the pulse amplitude decreases to <+1 V.

4.3.5 External Trigger Verification

a. Set the instrument controls as follows:

CONTROL	SETTING
REPETITION RATE selector	EXT
WIDTH selector	200 ns
WIDTH vernier	fully counterclockwise
OUTPUT vernier	MAX

b. Connect the trigger source to the EXT INPUT. Set the trigger source repetition rate for 200 kHz and the amplitude for +2 V into 50 ohms and the width >15 ns.

c. Monitor the OUTPUT with the sampling oscilloscope. Trigger the oscilloscope from the sync output of the trigger source.

d. Verify that the instrument is triggered at the repetition rate of the trigger source. Verify that the instrument can be triggered to >20 MHz.

4.3.6 Power Supply Verification (Model 88 only)

a. Connect the power plug to the autotransformer and the autotransformer to the power source. Set the autotransformer for 115/230 V ac.

b. Monitor the DC OUTPUT with the digital voltmeter and verify a reading of +5.00 V ±100 mV dc. If the reading is not in tolerance, adjust R559 for +5.00 V.

c. Connect a 5 ohm, 10 watt resistor across the DC OUTPUT. Verify that the voltmeter reading does not change more than ±50 mV dc.

d. Vary the line voltage from 90-138/180-276 V and verify that the voltmeter reading does not change more than ±50 mV dc.

e. Set the voltmeter to read ac voltage and verify that the ripple does not exceed 1.8 mV rms.

SECTION V

PARTS LIST

5.1 ABBREVIATIONS AND SYMBOLS

5.1.1 Reference Designations

Reference designations in the parts list correspond to the circuit symbols used in the following schematics:

Drawing Number 40000-504
Drawing Number 40000-508

5.1.2 Abbreviations

ampere	A
capacitor	C
diode	CR
fuse	F
inductor	L
integrated circuit	Z
kilohm	K
megohm	M
microfarad	μF
negative-positive-negative	NPN
picofarad	pF
positive-negative-positive	PNP
quadruple	Quad
single-pole-double-throw	SPDT
transformer	T
transistor	Q or Tstr.
variable	Var.
volts	V
watts	W

5.1.3 Manufacturers

Allen Bradley Company	AB
Arco Electronics Products	Arco
Bussman Manufacturing Company	Buss
Centralab Electronics Division	Centralab
Components Incorporated	Comp
Cornell Dubilier Electronics	CD
Corning Glass Works	Corning
Datapulse Division, Systron-Donner Corporation	DP
Electrocube Incorporated	Electrocube
Fairchild Semiconductor Products Incorporated	FT
Hewlett-Packard Associates	HPA
International Rectifier Company	IRC
Motorola Semiconductor Products Incorporated	Mot.
Sangamo Electric Company	Sangamo
Sprague Electric Company	Sprague
Sylvania Electric Products Division	Syl.
Wilco Corporation	Wilco

REF. NO.	DATAPULSE PART NO.	QTY. USED	DESCRIPTION	MFR.	MFR. PART NO.

5.2 FRONT PANEL ASSEMBLY-Model 88/99

REF. NO.	DATAPULSE PART NO.	QTY. USED	DESCRIPTION	MFR.	MFR. PART NO.
R313	20052-102	1	Var., 1 k, 1 W	AB	AB70A8056-S102U
S501	15280-001	1	Toggle, SPDT	DP	
CR518	15450-045	1	Light Emitting Diode	HPA	5082-4440
	15050-000	3	BNC Connectors	DP	
Model 88 only					
C553	11242-104	1	0.1 μF, 75 V	Centralab	DDA104
	15050-060	1	Banana Jack-Red	DP	
	15050-061	1	Banana Jack-Black	DP	

5.3 MAIN CIRCUIT BOARD ASSEMBLY

C1	11077-101	2	100 pF, 500 V	Arco	DM15E101J
C2	11510-336	1	33 μF, 10 V, 10%	Sangamo	C513AC330K
C3	11510-335	1	3.3 μF, 10 V, 10%	Sprague	150D335X-9010A2
C4	11127-334	1	0.33 μF, 200 V, 5%	Electro-cube	Z10B1C334J
C5	11127-333	1	0.033 μF, 200 V, 5%	Electro-cube	Z10B1C333J
C6	11075-332	1	3300 pF, 500 V, 5%	Arco	DM19-332J
C7	11077-271	1	270 pF, 500 V, 5%	Arco	DM15F271J
C8	11077-709	1	7 pF, 500 V, 5%	CD	CD6CD070-DO3
C9	11077-390	1	39 pF, 500 V, 5%	Arco	DM15E390J
C102	11241-223	15	0.022 μF, 25 V	Sprague	HY525
C103			Same as C1		
C104	11077-821	1	820 pF, 500 V, 5%	Arco	DM15F821J
C105	11083-103	1	0.01 μF, 100 F, 10%	CD	WMF-1S1
C106	11083-104	1	0.1 μF, 100 V, 10%	CD	WMF-1P1
C107	11511-108	1	1 μF, 20 V, 10%	Sprague	150D105X-9015A2
C108	11511-106	1	10 μF, 20 V, 10%	Comp	TE2-020-106-10
C109	11510-107	1	100 μF, 10 V, 10%	Mil. Std.	CSR13C-107KL
C301			Same as C102		
C302			Same as C102		
C303			Same as C102		
C304			Same as C102		
C305			Same as C102		
C306			Same as C102		
C307	11492-685	1	6.8 μF, 35 V	Sprague	196D685X-0035
C308	11491-226	2	22 μF, 25 V, 20%	Sprague	196D226X-0025LA3
C309			Same as C102		
C310			Same as C102		
C351			Same as C102		

REF. NO.	DATAPULSE PART NO.	QTY. USED	DESCRIPTION	MFR.	MFR. PART NO.
C352			Same as C102		
C511	11168-158	2	1500 μF, 50 V	STM	23C50TS152
C512			Same as C308		
C521			Same as C511		
C522	11510-336	2	33 μF, 10 V, 10%	Sangamo	C513AC330K
C531			Same as C102		
C532			Same as C102		
C533			Same as C102		
C534			Same as C102		
C535			Same as C522		
F501	15470-037	1	½A Slow-Blow	Buss	MDL½
L1	14284-002	1	1 μH	Wilco	205-11-10
L301	14284-006	2	2.7 μH	Wilco	210-11
L302			Same as L301		
L351	14254-332	1	3.3 μH	Wilco	W33G
R1	10010-203	1	20 k, ¼ W, 5%	AB	CB2035
R2	10010-391	2	390 ohm, ¼ W, 5%	AB	CB3915
R3	10010-101	7	100 ohm, ¼ W, 5%	AB	CB1015
R4	10010-103	4	10 k, ¼ W, 5%	AB	CB1035
R5	10010-102	5	1 k, ¼ W, 5%	AB	CB1025
R6	10010-301	1	300 ohm, ¼ W, 5%	AB	CB3015
R7	10010-153	1	15 k, ¼ W, 5%	AB	CB1535
R8	20042-103	1	Var., 10 k, 1 W	AB	70A8N056-S103B
R9	10010-621	1	620 ohm, ¼ W, 5%	AB	CB6215
R10	10010-181	1	180 ohm, ¼ W, 5%	AB	CB1815
R101			Same as R3		
R102			Same as R3		
R103			Same as R4		
R104	20042-253	1	Var., 25 k, 1 W	AB	70A8N056-S253A
R105	10010-242	2	2.4 k, ¼ W, 5%	AB	CB2425
R106	10010-182	1	1.8 k, ¼ W, 5%	AB	CB1825
R301	10010-221	3	220 ohm, ¼ W, 5%	AB	CB2215
R302			Same as R3		
R303			Same as R3		
R304	10010-821	3	820 ohm, ¼ W, 5%	AB	CB8215
R305	10010-511	1	510 ohm, ¼ W, 5%	AB	CB5115
R306	10010-431	2	430 ohm, ¼ W, 5%	AB	CB4315
R307	10010-151	1	150 ohm, ¼ W, 5%	AB	CB1515
R308			Same as R306		
R309	10010-331	1	330 ohm, ¼ W, 5%	AB	CB3315
R310			Same as R304		
R311			Same as R5		
R312	10010-911	1	910 ohm, ¼ W, 5%	AB	CB9115
R314	10010-332	1	3.3 k, ¼ W, 5%	AB	CB3325
R315	10012-201	1	200 ohm, 1 W, 5%	AB	GB2015
R316	10010-201	3	200 ohm, ¼ W, 5%	AB	CB2015
R317			Same as R316		
R318			Same as R316		
R319			Same as R4		
R320			Same as R4		
R321			Same as R105		
R322	10013-330	1	33 ohm, 2 W, 5%	AB	EB3305
R323	10011-680	1	68 ohm, ½ W, 5%	AB	GB6805

REF. NO.	DATAPULSE PART NO.	QTY. USED	DESCRIPTION	MFR.	MFR. PART NO.
R324	10010-279	3	2.7 ohm, ¼ W, 5%	AB	CB2795
R325			Same as R324		
R326			Same as R324		
R327			Same as R5		
R328			Same as R2		
R351			Same as R5		
R352			Same as R5		
R353	10013-101	1	100 ohm, 2 W, 5%	AB	HB1015
R354			Same as R301		
R511	10010-472	1	4.7 k, ¼ W, 5%	AB	CB4715
R512	10010-330	1	33 ohm, ¼ W, 5%	AB	CB3305
R513	10010-471	1	470 ohm, ¼ W, 5%	AB	CB4715
R514			Same as R3		
R515	10010-152	1	1.5 k, ¼ W, 5%	AB	CB1525
R516	10012-339	1	3.3 ohm, 1 W, 5%	AB	GB3395
R517			Same as R3		
R518	10011-301	1	300 ohm, ½ W, 5%	AB	EB3015
R521	10010-222	1	2.2 k, ¼ W, 5%	AB	CB2225
R522	10010-620	1	62 ohm, ¼ W, 5%	AB	CB6205
R523			Same as R304		
R524	10011-689	1	6.8 ohm, ½ W	AB	EB6295
R525	10010-510	1	51 ohm, ¼ W, 5%	AB	CB5105
R531	10010-512	1	5.1 k, ¼ W, 5%	AB	CB5125
R532	10010-202	1	2 k, ¼ W, 5%	AB	CB2025
R533			Same as R301		
R534	10723-680	1	68 ohm, 2 W, 5%	DP	
Q301	S22635-003	6	NPN	DP	
Q302			Same as Q301		
Q303	12605-002		PNP	Mot.	2N2904A
Q304			Same as Q301		
Q305			Same as Q301		
Q306			Same as Q301		
Q307	S22605-008	1	NPN	DP	DP608
Q308			Same as Q301		
Q310	12645-002	2	NPN	Mot.	2N2219A
Q511			Same as Q303		
Q513	12635-998	4	NPN	FT	2N3641
Q514			Same as Q513		
Q516			Same as Q513		
Q517			Same as Q513		
Q518			Same as Q310		
S1	A25260-005	1	Rotary	DP	
S101	A25250-056	1	Rotary	DP	
T501	C24010-040	1	Power	DP	
Z1	12953-010	1	IC Quad, Differential Amplifier	Mot.	MC10115
CR1	S22164-000	12	Silicon	DP	DP16-0
CR2			Same as CR1		
CR3			Same as CR1		
CR101	12224-003	3	Hot Carrier	HPA	5082-2811
CR301	12144-003	3	Germanium	Syl.	1N995
CR302			Same as CR1		
CR303			Same as CR1		
CR304	S22314-339	1	Zener, 3.3 V	DP	
CR305			Same as CR1		

REF. NO.	DATAPULSE PART NO.	QTY. USED	DESCRIPTION	MFR.	MFR. PART NO.
CR306			Same as CR101		
CR307			Same as CR1		
CR308			Same as CR1		
CR309			Same as CR1		
CR310			Same as CR101		
CR311			Same as CR1		
CR351			Same as CR301		
CR352			Same as CR301		
CR511	12194-005	8	Silicon	Mot.	1N4005
CR512			Same as CR511		
CR513			Same as CR511		
CR514			Same as CR511		
CR515			Same as CR1		
CR516			Same as CR1		
CR517	S22314-100	1	Zener, 10 V	DP	
CR521			Same as CR511		
CR522			Same as CR511		
CR523			Same as CR511		
CR524			Same as CR511		
CR525	S22314-479	1	Zener, 4.7 V	DP	
THE FOLLOWING PARTS USED ON MODEL 88 ONLY					
C551	11161-508	1	5000 μF, 15 V	STM	23C15TS53
C552	11510-336	1	33 μF, 10 V	Sangamo	C513AC330K
C554	11492-685	2	6.8 μF, 35 V	Sprague	196D685X-0035
C555			Same as C554		
C556	11241-223	1	0.022 μF, 25 V	Sprague	HY525
F501	15470-030	1	1A Slow-Blow	Buss	MDL-1
Q551	12605-002	1	PNP	FT	2N2904A
Q553	12635-998	1	NPN	FT	2N3641
Q554	12605-005	1	PNP	FT	2N3638
Q555	12695-007	2	NPN	Sprague	TZ82
Q556	22635-003	1	NPN	DP	DP633
Q557			Same as Q555		
R551	10010-472	2	4.7 k, ¼ W, 5%	AB	CB4725
R552	10010-560	1	56 ohm, ¼ W, 5%	AB	CB5605
R553	10010-562	1	5.6 k, ¼ W, 5%	AB	CB5625
R554	10710-402	1	4.02 k, ¼ W, 1%	Corning	NA60D
R555	10264-109	1	1 ohm, 3 W	Sprague	450E1R05
R556	10010-151	1	150 ohm, ¼ W, 5%	AB	CB1515
R557			Same as R551		
R558	10010-331	2	330 ohm, ¼ W, 5%	AB	CB3315
R559	10439-102	1	Var., 1 k, ½ W	AB	SV1021
R560	10710-502	1	4.99 k, ¼ W, 1%	Corning	NA60D
R561			Same as R558		
R562	10011-221	1	220 ohm, ½ W, 5%	AB	EB2215
R563	10010-103	1	10 k, ¼ W, 5%	AB	CB1035
R564	10010-102	1	1 k, ¼ W, 5%	AB	CB1025
R565	10010-473	2	47 k, ¼ W, 5%	AB	CB4735
R566	10010-560	1	56 ohm, ¼ W, 5%	AB	CB5605
R567			Same as R551		
Z551	12903-000	1	Operational Amplifier	FT	μA741
CR551	12374-001	4	Rectifier 2A	IRC	20A1
CR552			Same as CR551		

REF. NO.	DATAPULSE PART NO.	QTY. USED	DESCRIPTION	MFR.	MFR. PART NO.
CR553			Same as CR551		
CR554			Same as CR551		
CR555	22164-000	2	Silicon	DP	
CR556			Same as CR555		
CR557	12154-201	1	Zener, 9.1 V	Mot.	1N936
CR558	22314-569	1	Zener, 5.6 V	DP	
CR559	12375-000	1	Diode-SCR	Mot.	MCR407-1

5.4 BACK PANEL ASSEMBLY-MODEL 88/99

Q512	12666-000	1	PNP	Mot.	2N4921
Q515	12645-017	1	NPN	Mot.	MPS U02
Model 88 only					
Q552	12795-000	1	NPN	Mot.	MJE800

****
NOTES
****

****
NOTES
****

WARRANTY

Datapulse Incorporated warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, transistors, fuses or batteries which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective.

Instruments returned under this Warranty will not be accepted at the Datapulse plant without prior authorization by a Datapulse representative or by the service manager of Datapulse Incorporated.

Datapulse Incorporated reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of Datapulse Incorporated and Datapulse Incorporated neither assumes nor authorizes any other person to assume for them any other liability in connection with the sales of Datapulse Incorporated instruments.

www.manualsplus.com

1013328

SYSTRON-DONNER CORPORATION